5 | Parking Demand

As part of the Ninth Street Parking Analysis component of the City of Durham Downtown Parking Study, Kimley-Horn developed a unique parking analysis tool, Park+, which is intended to allow the City to measure how changes in land use, parking, trip distribution, parking price, and management strategies affect the demands of parking. The following section describes the Park+ modeling application for the Ninth Street area.

Introduction

The Park+ Model is largely modeled after traditional supply and demand evaluations, which includes a multi-step process for evaluating parking demand conditions for a development, community, or campus. The multi-step process typically includes gathering data, defining assumptions or characteristics, selecting generation rates, applying reduction factors, creating scenarios, and evaluating results.

The Park+ Model allows the user to consolidate gathered data, define assumptions and characteristics through a user friendly interface, develop unique generation factors through the Park+ Proximity Parking Approach, apply reduction factors related to multi-modal and demand management assumptions, create and run scenarios using the models predictive gravity modeling algorithm, and evaluate the results on multiple levels using Park+ selection sets that can drill down from the study area level to a specific block, node, or intersection.

The Park+ Model is built on the principle of proximity parking, which assumes that parking demands are generally handled within a specific walking radius of a demand generator. This methodology is founded on the relationship between walking distance, price, attractiveness of facility, and general user decision making. The result of this methodology is localized parking generation rates that are predictive of actual demand conditions, which are representative of realistic parking generation characteristics for individual land uses throughout the specified study area.

This principle of proximity parking is used in both the initial calibration process as well as the predictive allocation process, which defines how many people need to park and where they want park. While the general methodology of the Park+ Model follows traditional shared use parking generation concepts, it differs from how generation rates are calculated.

The Park+ Model includes a predictive gravity demand modeling algorithm that allocates projected parking demand to adjacent parking facilities based on walking distance, price, and general attractiveness of each facility. The gravity modeling algorithm used in this model was developed specifically for the applications found in Park+. The algorithm uses the range of walking distances, price, and facility types in the model to define localized scores related to each facility and land use pair. These scores are then used to define the percentage of parking demand allocated to each parking facility, up to a user specified maximum occupancy percentage, which is defined as one of the user inputs to reflect the perceived effective capacity conditions within each Park+ community or campus.

The outputs of the Park+ Model include parking demand, parking supply, general surplus or deficit, met demand, latent (unmet) demand, and traditional parking demand required. The parking demand metric is a summary of the demand generated for the entire study area (or for the selection area). The parking supply metric is a summary of the parking capacity for the entire study area (or the selection area). The surplus or deficit metric is simply the difference between the demand and supply metrics for the given area. The met demand metric describes the amount of parking demand that is actually allocated using the proximity parking methodology, within the study area or for a given selection area. The latent demand represents the amount of demand that is not met within each localized walking radius defined within the model. While the overall supply and demand may be met within a given scenario, there may still be localized deficiencies within specific areas of the model—latent demand captures and identifies these areas.

The outputs from Park+ can be evaluated for the entire study area for a smaller subset, which can define localized demands at the zone, block, node, or intersection level. The benefit of this analysis tool is that it allows the Park+ Model to be free from zonal boundaries, allowing the user to define analysis areas as various development plans or master planned scenarios are evaluated.

Study Area

The study area for the Ninth Street Park+ model generally follows the study area for the project study area, and includes all of the parking facilities observed during data collection proceedings, as well as the land uses that are associated with each parking facility counted during that time period. Figure 5.1 represents the general study area, with the brown polygons representing land uses and the grey polygons representing parking facilities.

Within the study area, there are the following approximate land use and parking characteristics:

- 20,000 square feet of auto service space
- 5,000 square feet of bank space
- 25,000 square feet of church space
- 112,000 square feet of retail space
- 11,000 square feet of lounge or nightlife space
- 46,000 square feet of office space
- 46,000 square feet of restaurant space
- 352 on-street parking spaces
- 995 off-street parking spaces

The following sections describe the model calibration process and the resulting supply and demand projections.

Figure 5.1 – Park+ Demand Analysis Study Area

Calibration Settings

The Park+ Calibration process uses existing parking demands (collected by the project team) to calibrate parking generation rates for each individual land use within the study area. The result is a more accurate depiction of parking generation characteristics for the study area, rather than depending on city/county code or national parking generation rates reported by the Institute of Transportation Engineers (ITE) or the Urban Land Institute (ULI). The Calibration process uses the previously described parking occupancy data, land use characteristics, multi-modal characteristics, public-private parking relationships, and area specific walking tolerances to define the adjusted generation rates.

The Ninth Street specific inputs are as follows:

Multi-Modal Inputs

The following graphic provides the model specific multi-modal inputs, which were pulled from 2010 U.S. Census data. In the absence of more specific information, the census data was applied to all user types within the study area.

Multi-Modal

Specify the scenario's percentage of transportation modes.

Mode	Employees %	Residents %	Visitors %	General %
Biking	2	2	2	2
Walking	3	3	3	3
Bus	4	4	4	4
Shuttle	0	0	0	0
Light Rail	0	0	0	0
Other	15	15	15	15

Public-Private Relationships

The following graphic provides a representation of some of the public-private parking relationships implemented in the model calibration process. These relationships represent parking that is provided solely for the benefit of a singular or small set of land uses. By setting these relationships, the model can accurately relate observed parking demands to specific uses in the study area, creating more realistic parking generation calculations during the calibration process.

Tools

Pricing Influence | Parking Management | Parking Allocation by Land Use | Parking Allocation by User Type

Maximum Occupancy Percentage 0.95 Select...

	Parking Facility	Land Use	Relationship
Delete	One World (Rear)	General Retail	Restricted
Delete	One World (Front)	General Retail	Restricted
Delete	Vin Rouge	Restaurant	Restricted
Delete	Vin Rouge	Restaurant	Restricted
Delete	Nancy Turtle	General Retail	Restricted

Walking Tolerances

The walking tolerances within the model represent how far a user is willing to walk from their parking space to their destination. The Park+ model defines walking tolerances for several user types, including residents, employees, visitors, and general users. The graphic to the right provides the Ninth Street specific walking tolerances, which are based on discussions of the area with project stakeholders and a general understanding of the area user characteristics.

Baseline Scenario

Enter values for the walking tolerances and click Calibrate to set the scenario as a baseline.

User Type	Walking Tolerance (ft)	Walking Tolerance (min)
Residents	800	3.33
Employees	400	1.67
Visitors	200	0.83
General	400	1.67

Calibrate | Cancel

Weekday Calibration Results

Based on the inputs described in the previous section, the following results were developed for the Park+ calibration process:

Statistics

General | Chart

Run

Click to choose a smaller demand analysis area

Demand

Proximity Based (in spaces)

Demand	835	Demand	835
Supply	1,347	Met Demand	835
Surplus/Deficit	512	Latent Demand	0

Traditional Demand Calculation

When evaluating the parking demands in this area, the single use parking demands would be 1,429

These results indicate that there is a 835 space peak hour demand for parking versus a 1,347 space supply within the study area, indicating that the study area is operating at approximately 62% of total supply. Additionally, the output indicates that the latent demand is zero spaces, meaning that the study area is able to meet all of the demand within the walking characteristics identified within the model. Finally, the model indicates that the demand when modeling within traditional demand metrics is 1,429 spaces, meaning that the actual demand is approximately 42% less than demand predicted by traditional measures (in this case ITE or ULI).

Figure 5.2 shows the actual occupancy of each of the parking facilities within the study area. This should closely resemble the data collection results (indicated on pages 1-6 and 1-7) because that data was used as the baseline for calibration.

Figure 5.2 – Park+ Weekday Calibrated Parking & Land Use Dataset

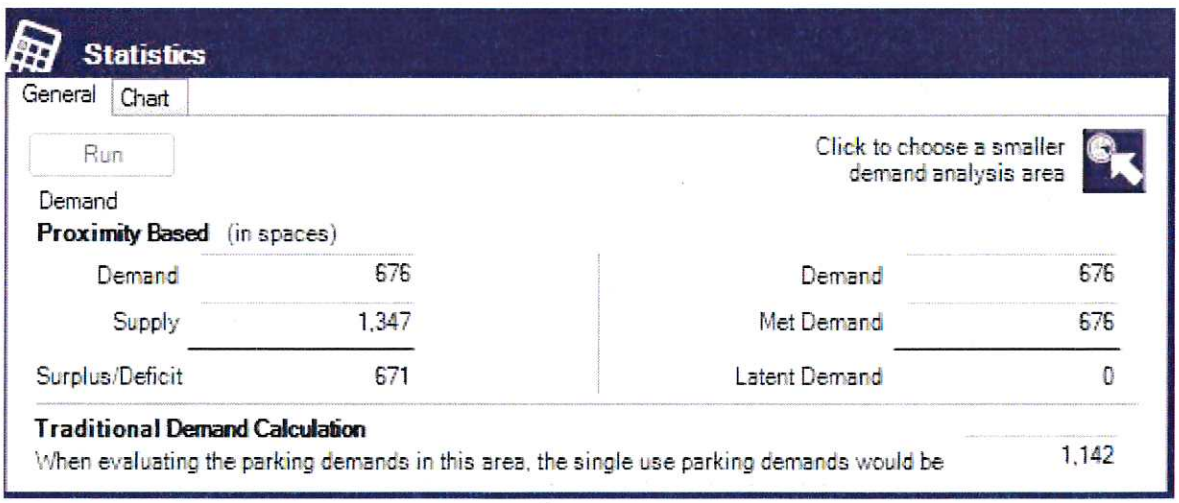
One of the key outputs of the calibration process is the development of location specific parking generation rates for each land use (and consolidated land use category). Table 5.1 provides a summation of the initial weekday parking generation rates for the Ninth Street area[1].

Table 5.1 – Ninth Street Weekday Parking Generation Rates

Land Use Category	Minimum Generation Rate	Maximum Generation Rate	Average Generation Rate	Traditional Generation Rate[2]
Auto Service	1.7 per ksf	13.5 per ksf	5.85 per ksf	4.17 per ksf
Bank	2.68 per ksf	6.15 per ksf	5.38 per ksf	2.64 per ksf
Retail	0.73 per ksf	13.01 per ksf	3.14 per ksf	1.13 per ksf
Nightlife	1.9 per ksf	12.8 per ksf	8.6 per ksf	16.5 per ksf
Office	0.35 per ksf	5.0 per ksf	3.0 per ksf	3.5 per ksf
Restaurant	0.55 per ksf	20.1 per ksf	8.1 per ksf	18 per ksf

Weekend Calibration Results

Based on the inputs described in the previous section, the following results were developed for the Park+ calibration process for a typical weekend:



These results indicate that there is a 676 space peak hour demand for parking versus a 1,347 space supply within the study area, indicating that the study area is operating at approximately 50% of total supply during typical weekend conditions. Additionally, the output indicates that the latent demand is zero spaces, meaning that the study area is able to meet all of the demand within the walking characteristics identified within the model. The model indicates that the demand when modeling within traditional demand metrics is 1,142 spaces, meaning that the actual demand is approximately 41% less than demand predicted by traditional measures (in this case ITE or ULI).

[1] The initial parking generation rates are based on the parking data collected as part of this study. The City should assimilate several iterations of data for a statistically significant sample size prior to incorporating these design characteristics into ordinance or governing documents.
[2] Traditional generation rate is based on ITE Parking Generation Manual, 4th Edition, or ULI Shared Parking Manual.

Figure 5.3 shows the actual occupancy of each of the parking facilities within the study area. This should closely resemble the data collection results because that data was used as the baseline for calibration.

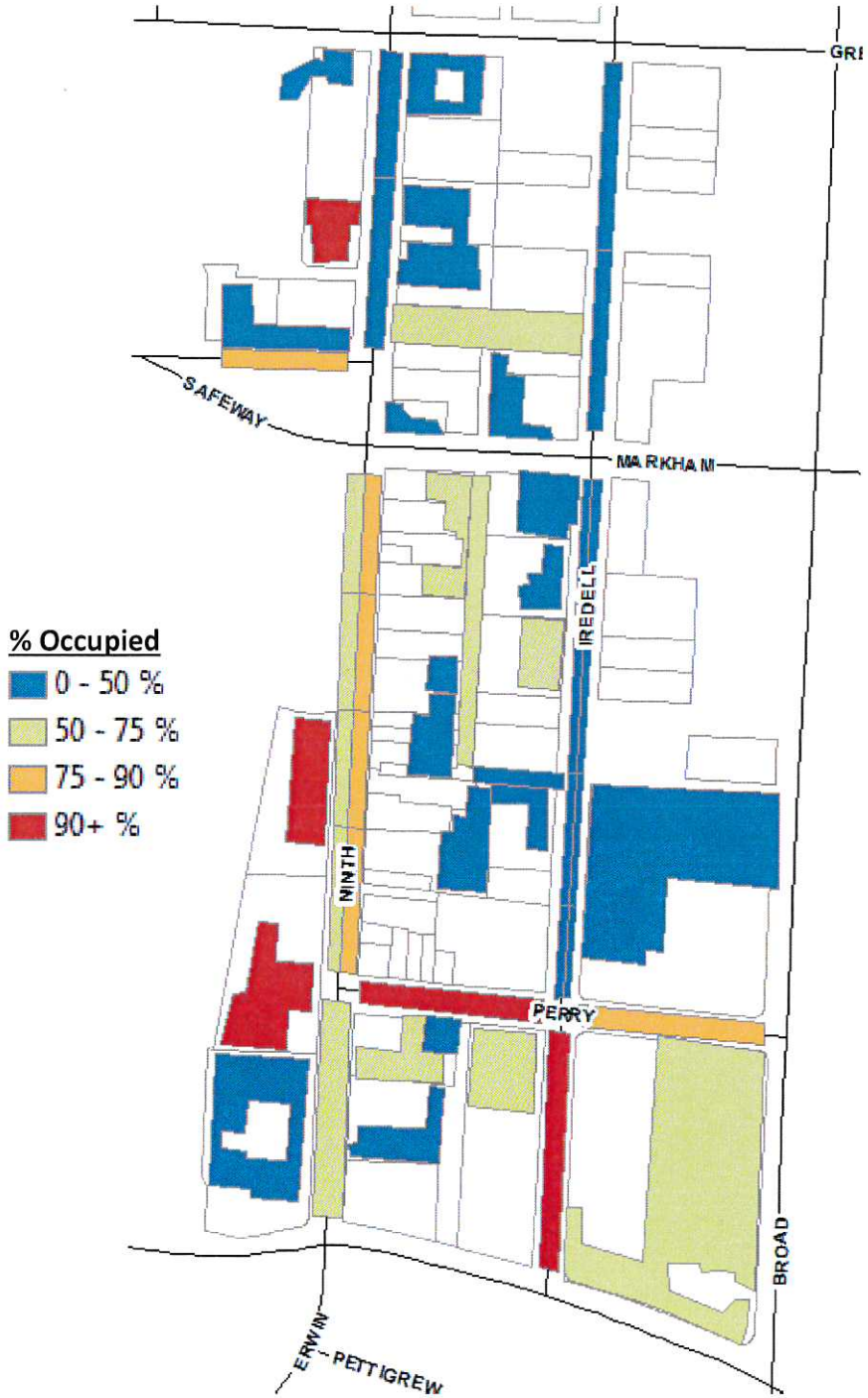


Figure 5.3 – Park+ Weekend Calibrated Parking & Land Use Dataset

Finally, one of the key outputs of the calibration process is the development of location specific parking generation rates for each land use (and consolidated land use category). Table 5.2 provides a summation of the initial weekend parking generation rates for the Ninth Street area[3].

Table 5.2 – Ninth Street Weekend Parking Generation Rates

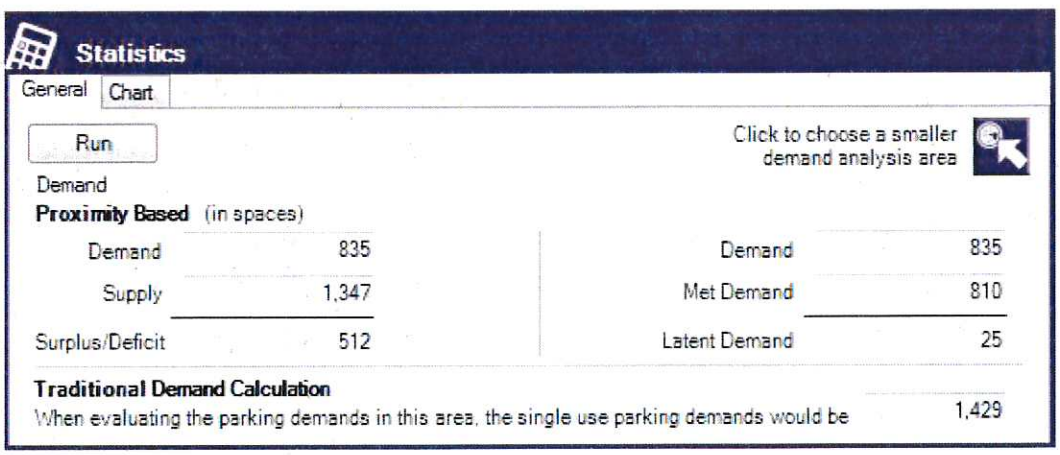
Land Use Category	Minimum Generation Rate	Maximum Generation Rate	Average Generation Rate	Traditional Generation Rate
Auto Service	3.0 per ksf	5.9 per ksf	4.1 per ksf	4.17 per ksf
Retail	1.9 per ksf	3.1 per ksf	2.7 per ksf	2.13 per ksf
Nightlife	1.4 per ksf	15.3 per ksf	8.6 per ksf	19 per ksf
Office	0.2 per ksf	5.1 per ksf	1.74 per ksf	0.35 per ksf
Restaurant	3.3 per ksf	18.6 per ksf	7.9 per ksf	20 per ksf

Projection Results

In addition to the calibration settings, the Park+ model is able to run projected conditions for the existing scenario, as well as additional scenarios. The projected conditions differ from calibration because the adjust for design-day conditions and predict where parkers would prefer to park if given the choice – based on the relationship between walking distance, price, and attractiveness of parking.

Weekday Results

The output below provides the initial existing weekday conditions projection from the model. The supply and demand results do not differ from the calibration process, because none of the inputs were changed. However, parking demands were allocated based on the Park+ principles of proximity parking, which is represented by Figure 5.4. The resulting latent demand, meaning parking demand not met within the walking characteristics identified within the model. The latent demand is occurring along Ninth Street, near the center of the study area (identified with red cross-hatch).



[3] The initial parking generation rates are based on the parking data collected as part of this study. The City should assimilate several iterations of data for a statistically significant sample size prior to incorporating these design characteristics into ordinance or governing documents.

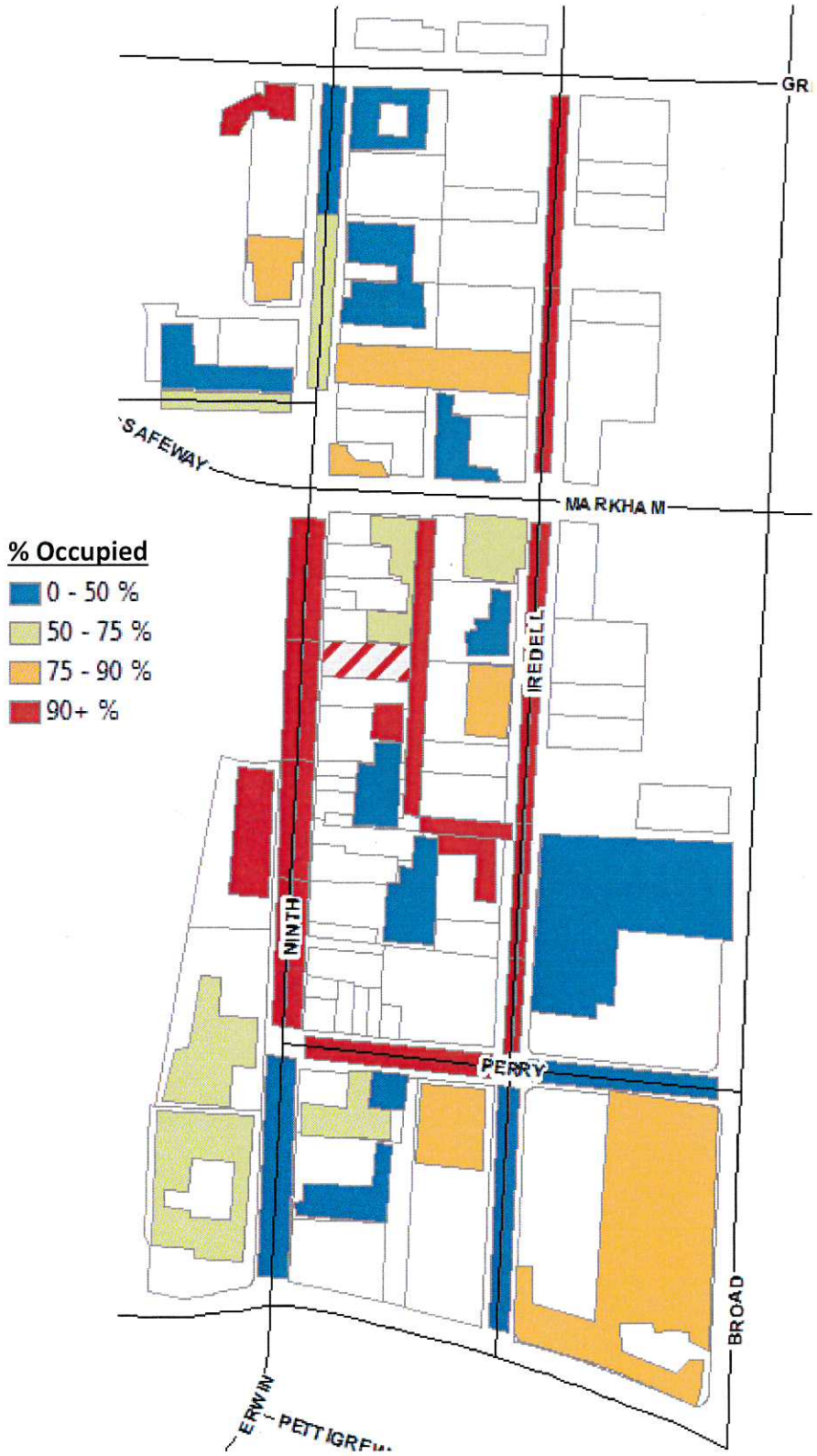
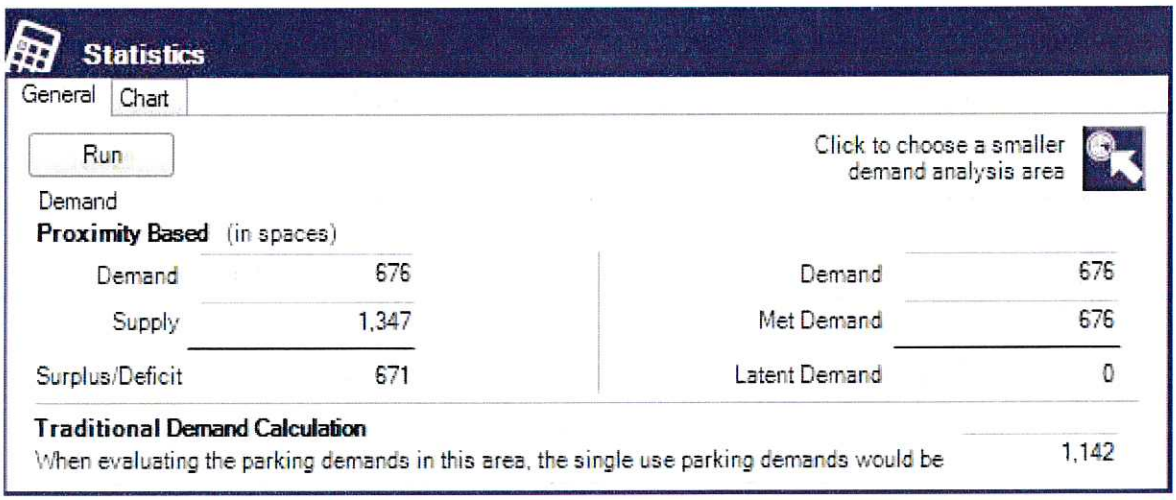


Figure 5.4 – Park+ Existing Weekday Scenario Demand Projections

Weekend Results

The output below provides the initial existing weekend conditions projection from the model. The general results do not differ from the calibration process because none of the inputs were changed. Parking demands were allocated based on the Park+ principles of proximity parking, which is represented by Figure 5.5.



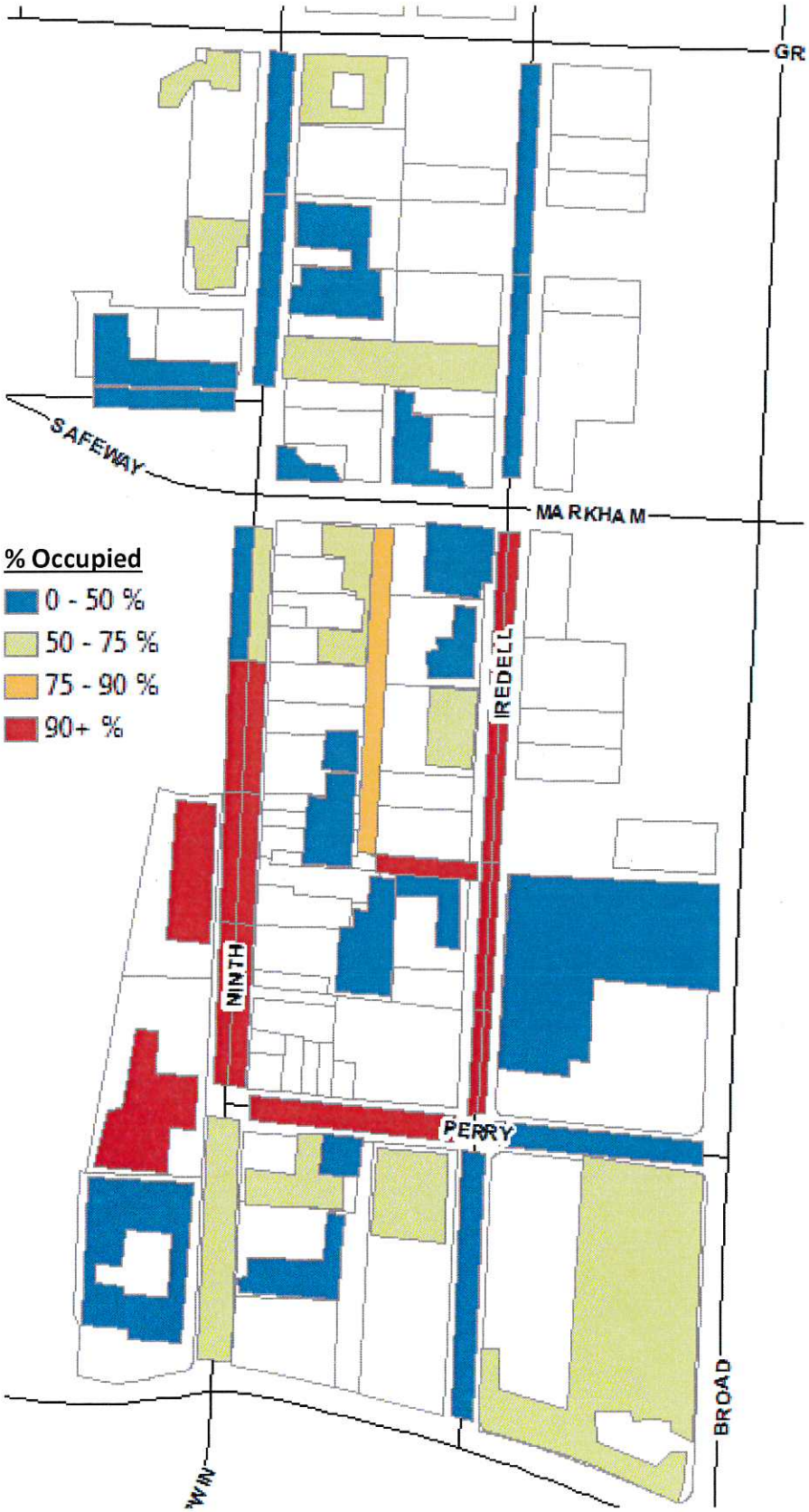
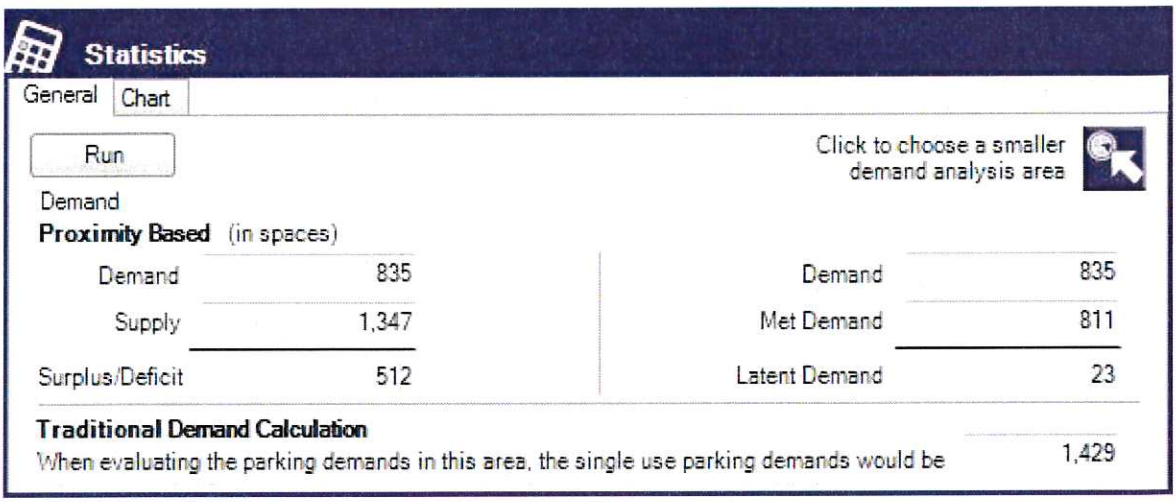


Figure 5.5 – Park+ Existing Weekend Scenario Demand Projections

Projection Scenario #1 – Paid Parking in the Ninth Street Timed Lot

The first projection that was developed for the Ninth Street Area was the application of paid parking in the Ninth Street lot. The model input criteria was held constant, but the pricing for the Ninth Street lot was set to $1.00 per hour, with a daily maximum of $8.00. The results from this projection are shown below.



The overall results do not differ from the previous projection. However, when visually reviewing the occupancy levels of the Ninth Street timed lot and surrounding on-street parking, it is clear that the introduction of a price for that lot influences behaviors for parkers in the area.

Figure 5.6 shows that weekday occupancy in the lot during the observed hour doesn't change much with the application of a price component, primarily because the demand for parking in that area is so high. Table 5.3 compares weekday occupancy levels from the initial projection to the scenario with the introduction of price.

Table 5.3 – Ninth Street Timed Lot Occupancy Comparison

Hour	Original Occupancy Level	Occupancy Level w/ Price	Delta
11:00 AM	95%	95%	0%
12:00 PM	95%	95%	0%
1:00 PM	95%	95%	0%
2:00 PM	95%	95%	0%
3:00 PM	93%	79%	-4%
4:00 PM	95%	95%	0%
5:00 PM	95%	95%	0%
6:00 PM	95%	65%	-30%

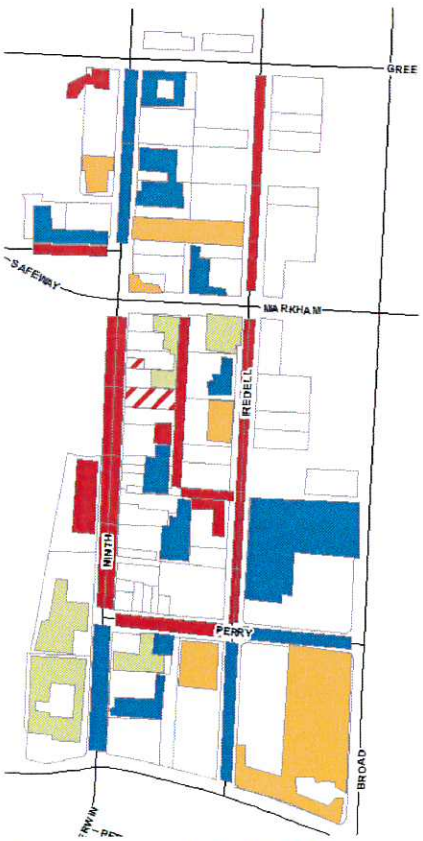
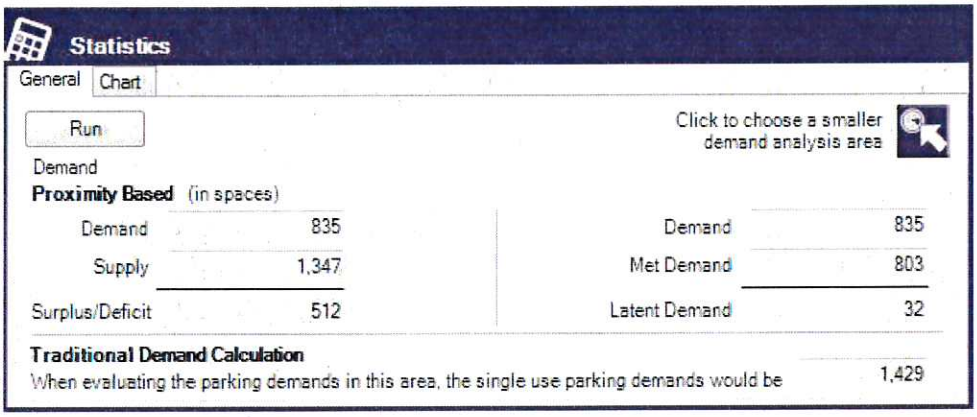


Figure 5.6 – Park+ Paid Off-Street Lot Demand Projections

Projection Scenario #2 – Paid Parking On-Street and in the Ninth Street Timed Lot

The second projection that was developed for the Ninth Street Area was the application of paid parking on-street, as well as in the Ninth Street lot. The model input criteria was held constant, but the pricing for on-street parking was set to $1.25 per hour, with three hours maximum duration of stay. The three hour duration of stay was implemented with the intent that restaurants and evening nightlife are best served with a longer duration of stay than the typical two hour window. As with the previous scenario, the Ninth Street lot was set to $1.00 per hour, with a daily maximum of $8.00. The results from this projection are shown below.



The overall results still do not differ from the previous projection, as we have not introduced a new demand generator into the system. However, when visually reviewing the occupancy levels of the Ninth Street timed lot and surrounding on-street parking, it is clear that the introduction of price structures for those parking areas affects behaviors for parkers in the area.

Figure 5.7 shows that weekday occupancy on-street changes somewhat in areas of lessor demand – however, in the Ninth Street retail area the demand for parking is too high to recognize demand balancing impacts. Table 5.4 compares weekday occupancy levels from the initial projection and the two scenarios introducing price as a component of parking in the area.

Table 5.4 – Ninth Street Timed Lot Occupancy Comparison

Hour	Original Occupancy Level	Occupancy Scenario 1	Occupancy Scenario 2
11:00 AM	95%	95%	95%
12:00 PM	95%	95%	95%
1:00 PM	95%	95%	95%
2:00 PM	95%	95%	95%
3:00 PM	93%	79%	95%
4:00 PM	95%	95%	95%
5:00 PM	95%	95%	95%
6:00 PM	95%	65%	95%

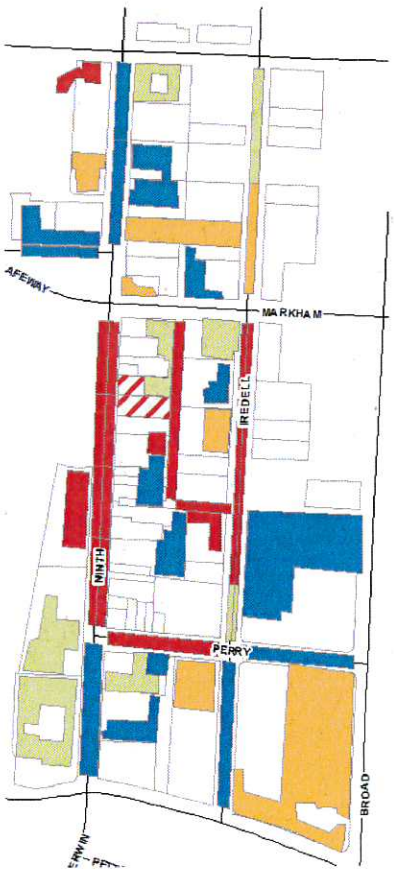


Figure 5.7 – Park+ Paid On- & Off-Street Lot Demand Projections

The introduction of paid on-street parking incrementally increases the occupancy levels in the Ninth Street Timed Lot back to the original demand levels during different times of day, as shown in Table 5.5.

Table 5.5 – Average On-Street Occupancy Comparison

Hour	Original Occupancy Level	Occupancy Scenario 1	Occupancy Scenario 2
11:00 AM	80%	78%	76%
12:00 PM	81%	79%	77%
1:00 PM	80%	81%	75%
2:00 PM	77%	77%	75%
3:00 PM	66%	70%	69%
4:00 PM	71%	73%	73%
5:00 PM	76%	74%	74%
6:00 PM	77%	77%	76%

The introduction of paid on-street parking incrementally lowers the average on-street parking occupancy throughout the area by approximately 1 – 5% during the different times of day. The average occupancy levels include all on-street parking in the area. The most utilized on-street parking areas, between Markham and Perry on Ninth Street and Iredell Street, still see higher than average occupancies.